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ABSTRACT

This report is an outgrowth of the Green Building Roundtable of the U.S. Senate Committee on Environment and Public Works held in conjunction with the U.S. Green Building Council on April 24, 2002. The roundtable brought together diverse interests to educate members of Congress on green building trends and generated discussion about the economic and health benefits of green building, the barriers facing its progress, and the opportunities available to federal agencies to further promote sustainable spaces. These issues are described in the report. Sections of the report also address the role of green building in schools' environmental quality and offer recommendations to improve school environments. (EV)

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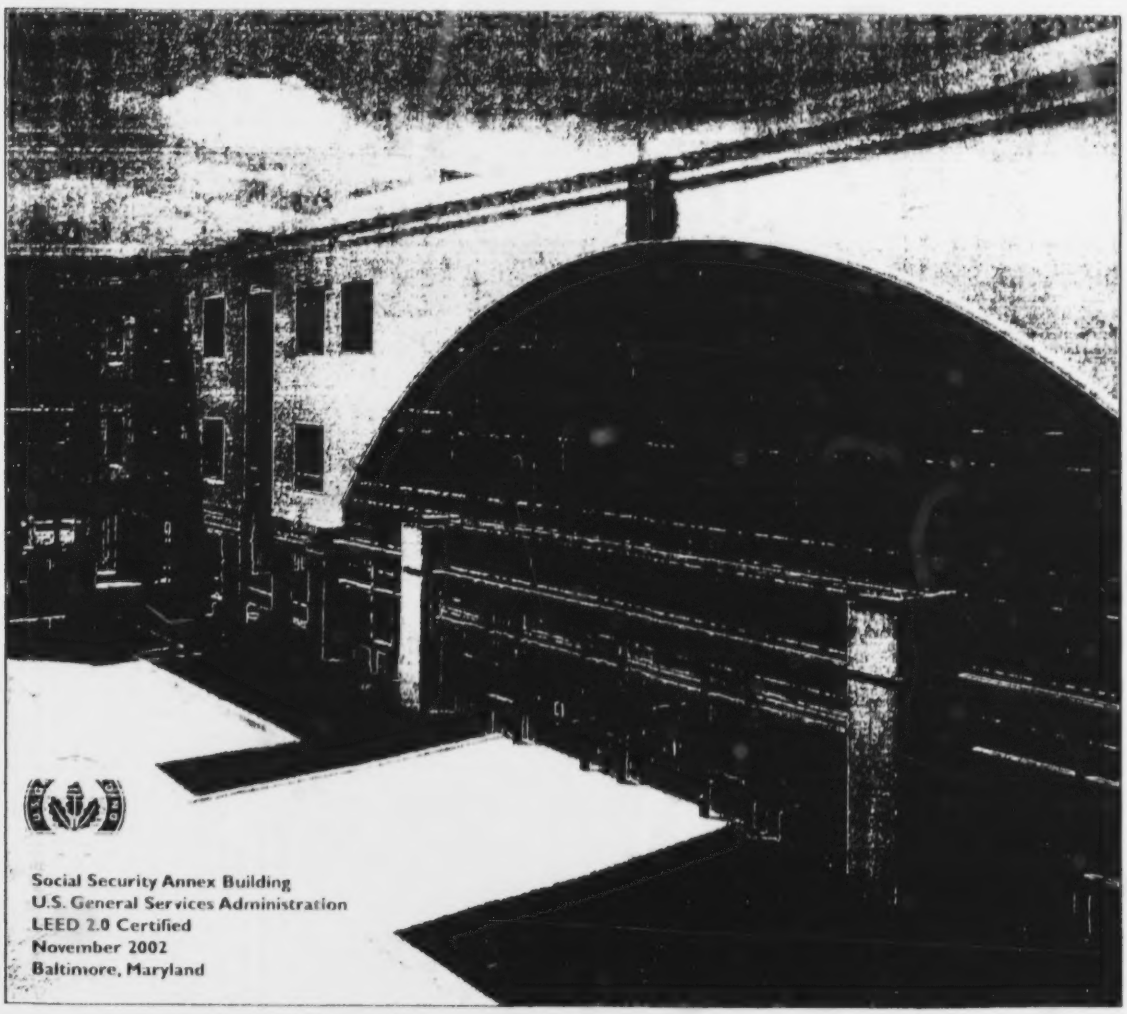
BUILDING MOMENTUM

NATIONAL TRENDS AND PROSPECTS FOR HIGH-PERFORMANCE GREEN BUILDINGS



Social Security Annex Building
U.S. General Services Administration
LEED 2.0 Certified
November 2002
Baltimore, Maryland

Based on the April 2002 Green Building Roundtable

And Prepared for the U.S. Senate Committee on Environment and Public Works

By the U.S. Green Building Council

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The U.S. Green Building Council would like to acknowledge Senator James Jeffords (I-VT), chairman of the Environment and Public Works Committee, and his staff for hosting the first Senate Green Building Roundtable and for their leadership on green building issues. We would also like to acknowledge Senator Ron Wyden (D-OR) and other members of the Environment and Public Works Committee and their staff who participated in the roundtable discussion and offered guidance on this report.

Participants in the April 24, 2002, Green Building Roundtable: Bob Berkebile, BNIM Architects; Mark Bundy, Maryland Department of Natural Resources; Bill Browning, Rocky Mountain Institute; Timothy S. Carey, Battery Park City Authority; Michael Chapman, Navy Facilities Engineering Command; Christine Ervin, U.S. Green Building Council; Mark Ginsberg, U.S. Department of Energy; Jim Hartzfeld, Interface Americas; Robert Hascall, Emory University; Kathleen Hogan, U.S. Environmental Protection Agency; Gunnar Hubbard, Davis Langdon Schumann Smith; Ken Hubbard, Hines Development; Vivian Loftness, Carnegie Mellon; Stephen Perry, Joseph Moravec, and Don Horn, U.S. General Services Administration; Jim Toothaker, Pennsylvania Department of Environmental Protection; Rob Watson, Natural Resources Defense Council; Alex Wilson, Environmental Building News, Steven Winter, Steven Winter Associates.

We would also like to acknowledge the contributions of the USGBC Executive Committee and federal agency team; Melisa Crawford, consultant (previously with The Heinz Endowments); Rob Watson; Kath Williams, Montana State University; and Alex Wilson. Thanks also to Claire Barnett, Executive Director of the Healthy Schools Network, for her contributions regarding school and children's environmental health issues.

Thanks to Gunnar Hubbard for his leadership in helping to launch the Roundtable and serving as project manager for this report.

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EXECUTIVE SUMMARY

Building Momentum: National Trends and Prospects for High-Performance Green Buildings is an outgrowth of the Green Building Roundtable of the U.S. Senate Committee on Environment and Public Works held in conjunction with the U.S. Green Building Council (USGBC) on April 24, 2002. The Roundtable brought together diverse interests to educate members of Congress on green building trends and generated discussion about the economic and health benefits of green building, the barriers facing its progress, and the opportunities available to federal agencies to further promote sustainable spaces.

> *"Our hope is that this is the beginning of a dialogue between Congress and green building interests. This dialogue should lead to action, and this action should result in the expansion of the benefits to all Americans that sustainable design brings."*
>
> —Senator James Jeffords

Trends and Opportunities

Buildings have a surprisingly profound impact on our natural environment, economy, health, and productivity. In the United States, the built environment accounts for approximately one-third of all energy, water, and materials consumption and generates similar proportions of pollution. The Environmental Protection Agency (EPA) classifies indoor air quality as one of the top five environmental health risks today, affecting the health and performance of occupants. Such health risks have special import for children in our nation's public schools. Emerging research studies point to intriguing links between green buildings and labor productivity—a business expense that dwarfs other building operating expenses.

As reported by Roundtable participants, rich opportunities exist to cost-effectively convert many of those liabilities into benefits. Numerous indicators point to the beginnings of a market transformation that will greatly enhance the way we design, construct, and operate buildings. Just three years ago, for example, no common definition existed for a "high-performance green building," and only a sprinkling of buildings across the country exhibited such features. Today, a diverse mix of more than 600 private and public buildings, comprising 86 million square feet, have registered for third-party certification under the nationally-accepted Leadership in Energy and Environmental Design (LEED™) standard developed by the U.S. Green Building Council. Over the nine month period since the April 24 Roundtable, Council membership has jumped from 1,500 companies and organizations to more than 2,600. Clearly, rapid changes are underway in the market. In addition to private company initiatives, a growing number of state and local governments across the country are encouraging green building practices through various financial, zoning, and other regulatory incentives. Prominent private foundations are beginning to incorporate high-performance green building initiatives into their program and capital budget portfolios.

The federal government has been a leader in the green building movement, including the U.S. General Services Administration (GSA), the U.S. Department of Defense, the U.S. Department of Energy (DOE), and EPA. *Building Momentum* highlights various policies and programs and showcases green buildings. Efforts are paying off—literally. The government's building-related energy costs have dropped 23 percent per square foot since 1985, saving taxpayers $1.4 billion to date.

Continuing advances in technologies, integrated design practices, and growing industry awareness will no doubt continue to transform a building industry characterized by relatively slow rates of innovation. A key challenge remains: how can the federal government work with the private sector to accelerate this trend and take full advantage of benefits? *Building Momentum* analyzes key barriers and opportunities for federal leadership.

Barriers

While many green buildings can be constructed at comparable or lower cost than conventional buildings, integration of high-performance features can increase initial costs from an average of 2 to 7 percent, depending on the design and extent of added features. Some of these features can recoup overall net costs in a relatively short period of time.

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Unfortunately, decision-makers rarely use life-cycle cost analysis to account for those reduced operating expenses or other kinds of benefits such as enhanced labor productivity and well-being. This first-cost bias also prevails in the federal sector, even though managers are required to conduct life-cycle costing.

Making a convincing business case for high-performance green buildings is further hindered by insufficient research. By any conventional yardstick, private and public investment in building-related research lags far behind that of other vital sectors. For example, the design, construction, and operation of buildings account for 20 percent of U.S. economic activity and more than 40 percent of energy used and pollution generated; yet far less than 1 percent of the federal research budget is allocated to buildings. The European Union spends six times more than the United States on research devoted to the built environment. Despite strong evidence that indoor environments affect health and learning, the major research funding agencies—the National Institutes of Health (NIH) and the National Science Foundation (NSF)—have no programs dedicated to building research. While international and domestic studies begin to link green design features to improved productivity, health, and learning, robust scientific analyses are needed to verify findings and quantify real benefits resulting from enhanced indoor environmental quality.

The U.S. Green Building Council

The U.S. Green Building Council is the nation's foremost non-profit coalition of nearly 3,000 companies and organizations from across the building industry promoting high-performance green buildings that are environmentally responsible, profitable, and healthy places to live and work. The U.S. Green Building Council developed LEED as a voluntary, consensus-based national standard to support and validate successful green building design, construction, and operations. LEED offers third-party certification of qualifying buildings, high-performance design guidelines, and professional training and accreditation services. After a project's completion, it may be qualified at LEED Certified, Silver, Gold or Platinum level.

Recommendations

As the country's largest landlord, the federal government can significantly accelerate the mainstreaming of high-performance building practices in the industry while saving taxpayer dollars. *Building Momentum* outlines specific recommendations that can strengthen markets for emerging technologies, provide stakeholders with needed tools and incentives, and fill research gaps. Among the most significant recommendations include the following:

- **Federal Agency Projects.** Strengthen existing federal policies relating to high-performance green building including the use of full-cost accounting results for determining construction priorities, and promoting LEED standards as benchmarks for federal building performance.

- **Research.** Boost funding for basic and applied research including the development of innovative materials, products, and technologies; exploring the relationship between green building features and human productivity; and quantification of environmental impacts associated with the extraction, manufacture, use, and disposal of building materials.

- **Economic Incentives and Data Collection.** Establish a national high-performance green building tax credit program with incentives for LEED certification to ensure that projects deliver promised benefits, and collect benefit/cost data on green buildings.

- **Schools.** Fund and implement the Healthy and High-Performance Schools provisions enacted in the Leave No Child Behind Act of 2001.

INTRODUCTION

On April 24, 2002, the Senate Committee on Environment and Public Works, chaired by Senator James Jeffords (I-VT), convened a Green Building Roundtable in conjunction with the U.S. Green Building Council. The Roundtable brought together representatives from diverse interests—government, academia, the private sector, and the nonprofit community—to educate congressional members and their staffs on green building trends. The roundtable, the first of its kind in Congress, generated a vibrant dialogue about the economic and health benefits of green building, the barriers facing its progress, and the opportunities available to federal agencies to further promote sustainable spaces.

"For the first time in my memory, this committee will look at indoor space... the built environment. We spend much of our time inside the walls of office buildings, schools, and homes, but we seem to know little about the potential to improve this space, until now. Today, buildings need to incorporate energy efficiency, waste reduction, reduced water consumption, healthy work environments, clean indoor air, and many other green design features. With these improvements will come a better quality of life for all Americans, enhanced economic vitality, and a smaller environmental footprint."

—Senator James Jeffords

The Economic, Environmental, and Social Impacts of Buildings

The construction and operation of buildings consume tremendous amounts of natural resources while producing wastes and pollutants that contribute to environmental damage and potentially compromise the health and productivity of building occupants. While our offices, homes, and schools may not have tailpipes or smokestacks, building development and use causes pollution all the same. According to DOE, there are more than 76 million residential buildings and nearly 5 million commercial buildings in the United States today.

Collectively, these buildings consume:[1]

- 37 percent of all energy used in the United States
- 68 percent of all electricity
- 12 percent of fresh water supplies and 88 percent of potable water supplies
- 40 percent of raw materials

Collectively, these buildings generate:

- More than one-third of municipal solid waste streams
- 36 percent of total emissions of anthropogenic carbon dioxide (CO_2) emissions, the primary greenhouse gas associated with global climate change
- 46 percent of sulfur dioxide emissions (SO_2)—a precursor to acidic deposition—through the consumption of fossil-fuel-fired electricity
- 19 percent of nitrogen oxide emissions (NOx), and 10 percent of fine particulate emissions

INDOOR ENVIRONMENTAL QUALITY

A Growing Health Concern

Indoor air can contain a number of potentially harmful chemicals and biological agents, including carbon dioxide, volatile organic compounds (VOCs), molds, various allergens, and infectious agents. EPA classifies indoor air quality as one of the top five environmental health risks today, and there is growing evidence that poor indoor air quality affects the health and performance of the people who work, live, and study in buildings:

- **Air pollution concentrations indoors can be 2 to 5 times higher than the air we breathe outside, with some measurements 100 times greater.**
- **An investigation of 20 studies with 30,000 subjects found significant associations between low ventilation rates and higher carbon dioxide concentrations where sick building syndrome symptoms were prevalent.**
- **A Lawrence Berkeley National Laboratory study (2000) found that building characteristics and indoor environments significantly influence the occurrence of communicable respiratory illness, allergy, and asthma symptoms, sick building symptoms, and worker performance.**
- **This same study estimated the potential national savings from health and productivity gains after indoor environmental quality improvements would fall between $23 and $56 billion.**

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The U.S. Green Building Council

The U.S. Green Building Council, is the nation's foremost non-profit coalition of nearly 3,000 companies and organizations from across the building industry promoting high-performance green buildings that are environmentally responsible, profitable, and healthy places to live and work. A diversity of interests have converged to promote green buildings. Council members include GSA and the Centers for Disease Control; Johnson Controls and leading automobile manufacturers; the Natural Resources Defense Council and the Rocky Mountain Institute; Turner Construction and Hines Development; the Packard Foundation and The Heinz Endowments; and numerous state and local governments and professional firms. The Council also has more than twenty chapters forming across the country.

Leadership in Energy and Environmental Design (LEED), developed by the USGBC, is a voluntary, consensus-based national standard to support and validate successful green building design, construction, and operations. LEED offers third-party certification of qualifying buildings, high-performance design guidelines, and professional training and accreditation services. After a project's completion, it may be qualified at LEED Certified, Silver, Gold or Platinum level. Also in development are LEED rating criteria for existing buildings, commercial interiors, homes, and various applications for special markets such as retail stores, laboratories, and schools.

Making the Business Case

For High-Performance Green Buildings

The Green Building Roundtable challenged international developer Hines and the U.S. Green Building Council to describe the economic arguments for green buildings. The resulting pamphlet, "Making the Business Case for High-Performance Green Buildings," produced in partnership with the Urban Land Institute and The Real Estate Roundtable, details the top ten reasons:

In the event that up-front costs are higher, they can be recovered through lower operating costs.

Integrating design features lowers ongoing operating costs.

Better buildings equate to better employee productivity.

New technologies enhance health and well-being.

Healthier buildings can reduce liability.

Tenant costs can be reduced significantly.

Property value will increase.

Many financial incentive programs are available for green buildings.

Communities will notice your efforts.

Using best practices yields more predictable results.

(PM-10 and PM-2.5), all of which cause air quality problems such as smog and acid rain or present direct risks to human health
- Indoor air contaminants that affect human health and performance

The construction industry—in terms of materials manufactured, design and engineering jobs, material shipping, construction, real estate, facilities management, and investments in buildings—accounts for 20 percent of the U.S. economy.[2] Yet, the majority of buildings are still designed and constructed with little regard for environmental impacts or occupant well-being. The challenge is to build more intelligently. But what exactly does it mean to build green?

What is a "Green" Building?

Green buildings are designed, constructed, and operated to boost environmental, economic, health, and productivity performance over that of conventional building. As reflected in the U.S. Green Building Council's voluntary LEED rating system, widely accepted as the national standard for green buildings, an integrated design approach addresses the potential of the site itself, water conservation, energy efficiency and renewable energy, selection of materials, and indoor environmental quality. A project that meets higher levels of LEED certification can include a wide array of features such as stormwater retention through landscaping, innovative wastewater technologies, reflective roofs, energy generating sources, personal

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comfort controls, certified woods, low-emitting materials, and advanced monitoring systems to assure that the building meets design objectives. A green building approach also embraces not just how we build but also where we build, taking into consideration site selection, development density, transportation, and other factors that contribute to smart growth. This intersection between the building itself and smart growth is a field attracting more attention in the industry today.

"If Thomas Jefferson were a part of this hearing he might be startled by some of the changes since he was in the neighborhood. He would have written a message by hand and sent it to Europe on a boat and waited for the response.
We can accomplish this in an instant.
On the other hand, if he looked at how we are building houses and buildings, they're not unlike what he was doing at Monticello more than 200 years ago.
He might say, with that kind of advancement, why don't your houses make their own energy?
Why don't they make their residents healthier and more productive? Why don't they add vitality to their neighborhoods? Why don't they host landscapes that clean the air and water?
Why don't they include a transportation system that runs on hydrogen or urban waste?
I think these are questions that we can answer today in the affirmative in every case."

Bob Berkebile, Architect

COMPELLING BENEFITS

The Tremendous Potential of Green Buildings

Many of the benefits of employing green building technologies and practices for occupants, owners, the environment, and society at large are quantifiable and well documented. These benefits include measurable reduction of waste, decreased water use, energy savings, reduced operating and maintenance costs, and improved indoor air quality. Other benefits are less tangible and harder to demonstrate statistically, such as improvements in occupant health, employee morale, productivity, recruitment, retention, and improved public image for organizations that build green. While comprehensive scientific studies are needed to verify results, preliminary studies and anecdotal evidence are confirming intuitive assumptions about the benefits of green buildings. Many building and health experts agree that the social benefits of green building technologies and practices can produce financial returns for employers that overshadow the savings associated with more measurable building performance gains.

Financial and Economic Benefits

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No Increase in First Costs

Many green buildings cost no more to build—or may even cost less—than conventional alternatives because resource-efficient strategies and integrated design often allow downsizing of more costly mechanical, electrical, and structural systems. For instance, the cost of building **Johnson Control's Brengel Technology Center** in Milwaukee was on par with prevailing construction rates, despite numerous high-tech

TWENTY RIVER TERRACE

— Battery Park City, New York

This 27-story glass and brick residential tower currently under construction in Battery Park City is the first green residential high-rise building in Manhattan. The project incorporates a broad range of environmental strategies. Natural gas absorption chillers increase energy efficiency and reduce peak electrical loads. Captured waste heat provides hot water to the apartments. Building-integrated photovoltaic cells reduce peak demand of grid electricity by 5 percent. A blackwater recycling plant provides treated water for use in the toilets, cooling tower, and for irrigation. Roofs are extensively planted using a continuous membrane. All interior materials were selected to reduce off-gassing and maximize recycled content. A dedicated room for a fuel cell will be set aside for future adaptation.

Credit: Rendering by DeBor, Inc. Courtesy Cesar Pelli & Associates

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Credit: Bill Browning, Rocky Mountain Institute

VERIFONE

— Costa Mesa, California

In a renovation of its worldwide distribution headquarters for its telephone credit card verification systems in Southern California, VeriFone, a division of Hewlett-Packard, reduced energy consumption by 59 percent, decreased employee absenteeism by 47 percent, and increased employee productivity by 5 percent. The tilt-up concrete structure features skylights for daylighting, a high-efficiency mechanical system, building materials with minimal VOCs, and ergonomic office systems. VeriFone's investments in the building's green features achieved a return on investment of more than 100 percent, with a payback of less than one year.

features like personal comfort control systems, multimedia systems, and information tracking systems. **S.C. Johnson's Worldwide Headquarters** in Racine, Wisconsin, incorporated elements such as personal environmental systems, a restored natural site, and extensive daylighting at a cost 10-15 percent *below* the U.S. average for comparable office and laboratory space.

High-Performance Green Buildings are Cost-Effective
Even for projects loaded with high-value features, higher first costs are often recovered within three to five years through lower operating expenses and utility rebates for energy-saving equipment. Savings in energy costs of 20-50 percent are common through integrated planning, site orientation, energy-saving technologies, on-site renewable energy systems, light-reflective materials, natural daylight and ventilation, and downsized equipment. According to a report released by EPA in 2002, ENERGY STAR-labeled office buildings cost an average of $0.86 per square foot per year to operate—40 percent less than the average office building. For international developer and investor Hines, efficiencies gained from its ENERGY STAR buildings are generating $13 million in annual savings.

Illuminating with Natural Light Can Boost Sales
Studies show that daylighting has a significant potential to increase sales for retailers. Skylights incorporated into **Wal-Mart's prototype Eco-Mart** in Lawrence, Kansas yielded a surprising discovery. To cut costs, skylights were installed over only half the store. Sales pressure (sales per square foot) was significantly higher for those departments with access to natural light. Wal-Mart subsequently mandated daylighting in all new stores. Studies of other retail businesses reveal similar findings. One study found that sales in stores with skylights were up to 40 percent higher compared with similar stores without skylights.[3]

Increased Resale Value of Energy-Efficient Homes
Homeowners can reduce their financial risk by making investments in energy efficiency that earn a higher rate of return than the stock market or bonds. A study published in *The Appraisal Journal* (October 1998) showed that energy efficiency upgrades can increase home value by more than the cost of the upgrade, especially in the face of rising utility costs. The study found that home value increases by $20 for every $1 in reduction in annual utility bills. Investing today in 10 recommended energy upgrades could yield a 23 percent return and increase home value by more than the total upgrade cost.

Increased Value for Developers and Owners
There is growing confidence in the industry that a high-performance green building can either capture lease premiums or present a more competitive property in an otherwise tough market. Reduced operating costs also generate increased cash flow, which helps free capital for other investments. As green buildings are recognized increasingly by LEED and ENERGY STAR, the marketplace is expected to follow with a system of preferential pricing. Recently, **USAA Realty Company's La Paz Office Plaza** in Orange County experienced an increase in market value of $0.80 per square foot—a $1.5 million increase—stemming from its investments in energy efficiency measures and lower-priced power procurements.

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Improved Health and Productivity

Boost Employee Productivity

Design features that enhance energy efficiency and indoor air quality are cost-effective strategies for improving worker productivity and product quality. An increase of 1 percent in productivity (measured by production rate, production quality, or absenteeism) can provide savings to a facility that exceeds its entire energy bill.[4] It is easy to see why this is the case by comparing the relative operating costs for commercial business. On average, annualized costs for personnel amount to $200 per square foot—compared with $20 per square foot for bricks and mortar and $2 per square foot for energy. A modest investment in soft features, such as access to pleasant views, increased daylight, fresh air, and personal environment controls, can quickly translate into significant bottom-line savings. **Lockheed's engineering development and design facility** in Sunnyvale, California illustrates the point. Lockheed managers reported a 15 percent drop in employee absenteeism—a savings that paid for the incremental costs of their new high-performance facility in the first year alone. A simple lighting retrofit at the **Postal Sorting Facility** in Reno, Nevada, enhanced visibility for workers. The result? A 6 percent increase in the number of mail pieces sorted per hour—a productivity gain worth more than the cost of the retrofit.

PITTSBURGH CONVENTION CENTER

— Pittsburgh, Pennsylvania

At 1.5 million square feet, the Pittsburgh Convention Center, which is aiming for LEED Gold certification, is one of the largest green buildings in the nation. The facility is one of the first convention centers to incorporate natural light and ventilation into its design.

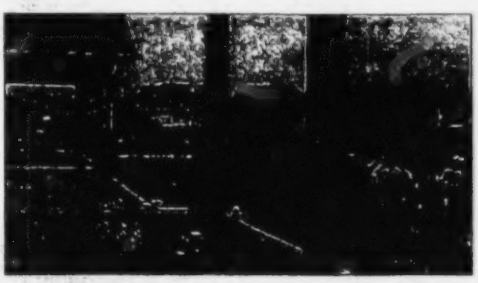
Credit: Dave Denomo, Heinz Endowments

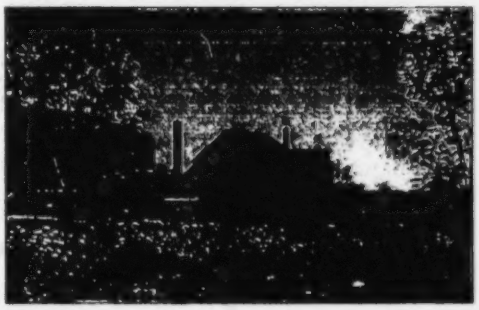
Remember that green building is not only about energy but also about health, comfort, and productivity, in addition to the environment.

— Steven W[illegible] V[illegible]

Enhanced Occupant Health and Well-Being

High-performance green buildings typically offer healthier and more satisfying work environments for tenants. A recent Lawrence Berkeley National Laboratory study reported that commonly





PRAIRIE CROSSING

— Prairie Crossing, Illinois

This unique 667-acre residential development, located 40 miles from Chicago, is dedicated to environmental preservation and community sustainability. To achieve these goals, 50 percent of the site has been protected from any future development, with 200 acres of restored native ecosystems and 150 acres dedicated to wetlands and agricultural production. Efforts to encourage community interaction include the preservation of a village green, trail development, a lake, and a community supported garden. Many of the Prairie Crossing homes meet EPA's ENERGY STAR standards for residences.

Credit: Bill Browning, Rocky Mountain Institute

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School Environmental Quality

Children at Risk

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Every day, 50 million children attend school. The American Society of Civil Engineers reported that our aging schools are in worse condition than any other infrastructure, including prisons. EPA estimates that 40 percent of our nation's 115,000 schools suffer from poor environmental conditions that may compromise health, safety, and learning of more than 14 million students. These conditions—which include asbestos, lead, radon, pesticides, cleaning agents, building materials, molds, leaking roofs, underground fuel tanks, poor heating and ventilation systems, inadequate lighting, and failing plumbing—contribute to a host of health concerns for both students and personnel. Problems are compounded by density. Schools have four times the number of occupants per square foot than most offices.

On October 1, 2002, the Senate Environment and Public Works Committee held a hearing on Environmental Standards for Schools that addressed the deteriorating quality of the nation's kindergarten through secondary (K-12) facilities, characteristics of child health vulnerabilities, and measures to elevate school environmental standards.

- Asthma, which affects 1 in 13 children, is the leading cause of school absenteeism, resulting in 14 million missed school days each year. Major indoor triggers of asthma attacks include irritants such as commercial products (paints, cleaning agents, pesticides, perfumes), building components (sealants, plastics, adhesives, insulation materials), animal and insect allergens, environmental tobacco smoke, and molds. Many of these triggers can be found in schools.

- A 1999 survey of Minnesota schools reported that approximately 47 percent of responding custodians sprayed pesticides "as needed" in the classroom. One third reported the same frequency of pesticide use in locker rooms, gymnasiums, cafeteria, and kitchens.[6] Forty percent of these custodians reported that their schools provided no notification of pesticide use. There is no federal statute requiring the collection of data on pesticide use in schools.

- A study of the prevalence of lead in California public elementary schools reported that 90 percent of all schools surveyed had lead-containing paint. Thirty-two percent surveyed had both lead-based paint and some deterioration of the paint surface. Detectable amounts of lead were also reported in drinking water at 53 percent of all schools in the study. No federal law requires blood-lead testing or lead abatement in schools.

- A study in five states found more than 1,100 schools built within a half-mile of a Superfund site.

- Twenty-four teenage boys in Elmira, New York who suffer from testicular cancer all attended the same school located on contaminated land.[7]

- A survey of New York State school nurses found that 71 percent reported knowing students whose health, learning, or behavior was affected by adverse building conditions.[8]

School environmental health is an orphan issue. No federal agency is responsible for the health and safety of children in school, and most school facilities operate with little state or local oversight. A National Academy of Sciences study suggested that at least 28 percent of developmental disabilities are due to environmental causes. While significant school expansion is taking place—to the tune of $20 billion in construction in 2002—less than 5 percent of new schools will be built to high environmental standards, and approximately $254 billion is required to bring existing school buildings up to basic health and safety codes.

Indoor Environmental Quality Programs Improve Student Health and Performance

- EPA's IAQ Tools for Schools voluntary program helps schools assess indoor air quality problems and teaches school staff to prevent and resolve issues through practical, low- or no-cost solutions. A school nurse at Little Harbour School in Portsmouth, New Hampshire reported a "dramatic decrease" in visits to her office after the school implemented Tools for Schools.

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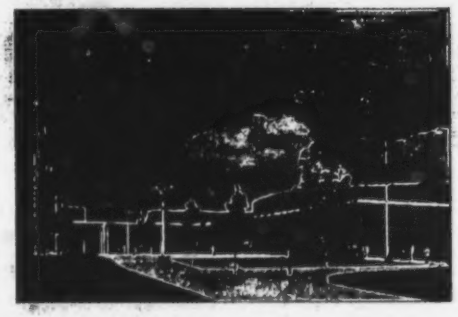
- EnergySmart Schools, developed under DOE's Rebuild America program, works with school districts to introduce energy-saving improvements to the physical environment and promote energy education.
- A landmark study in California, which analyzed test scores of 21,000 students, concluded that students in classrooms with the most natural light scored 20 percent higher on math tests and 26 percent higher on reading tests than did students in classrooms with the least amount of daylighting.
- A two-year study of six schools in Johnston County, North Carolina concluded that children attending schools with full-spectrum light were healthier in general and absent on average 3-4 days less than were students in conventionally lit classrooms.
- Green building features have pedagogical value. For example, at the Blusview Elementary School in Columbus, Ohio, solar panels not only reduced school energy consumption but also provided a hands-on learning tool for students. When discussed in the curriculum, math and science scores increased between 5 and 20 percent.
- At least 12 states (including Maine, Minnesota, New York, and California) have adopted policies or regulations to improve indoor air quality in existing schools. California's voluntary Collaborative for High Performance Schools (CHPS) provides detailed guidelines and support materials tailored to school needs. New York's regulation works to maintain standards at existing facilities and protect occupants in schools undergoing renovations.
- The U.S. Green Building Council plans to develop a national LEED application guide for schools in partnership with a diverse set of stakeholders.
- Congress passed Healthy and High-Performance Schools as part of the No Child Left Behind Act of 2001, which directs the U.S. Department of Education to study the effects of deteriorating schools on child health and learning and to establish grant incentives to help states renovate local schools to high-performance standards. The study is partially underway, but the Bush Administration has not requested funding for the program that would pay for technical assistance to local schools.
- The Administration also did not renew a $1.2 billion urgent healthy and safety repair and renovation program that targeted needy districts in every state.



CLACKAMAS HIGH SCHOOL

— Portland, Oregon

Architects and engineers created a dynamic learning space for 1,800 students that achieved exceptional energy savings. Windows, skylights, and light shelves provide natural light views to 90 percent of occupied spaces. Mechanically controlled dampers, louvers, and air stacks provide natural ventilation and cooling. Concrete slabs and masonry walls serve as thermal mass to stabilize interior air temperatures. A palette of low-emitting materials further improves indoor air quality. School officials anticipate the building will use 44 percent less energy than a conventional building, saving the school district at least $69,000 per year in energy costs. Total costs for the LEED certified Silver building were $117 per square foot, compared with $140 for a typical high school.

Credit: Michael Mathers

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recommended improvements to indoor environments could reduce health care costs and work losses from communicable respiratory diseases by 9-20 percent, from reduced allergies and asthma by 18-25 percent, and from other non-specific health and discomfort effects by 20-50 percent. The researchers also found that the improvements would generate savings of $17 to 48 billion annually in lost work and health care costs.

Children's Health and Learning

Studies are confirming what teachers, students, and parents have known intuitively for years: school facilities with high-performance features produce an environment in which students perform better. A California study reported that students in classrooms with the most daylighting scored 20 percent higher on math tests and 26 percent higher on reading tests than did students in classrooms with the least amount of natural light.[5] Healthy construction methods and materials could also help reduce the incidence of asthma, which is the number one cause of absenteeism for both students and teachers. (See inset box "School Environmental Quality" on pages 8 and 9 for more information.)

Environmental and Community Benefits

Stretch Local Infrastructure Capacity

Decreased energy and material requirements coupled with appropriate siting help stretch the capacity of public systems for grid-supplied power, water, wastewater, and transportation. Many of these systems have become overburdened in recent years, illustrated by the California energy brownouts in 2001. A study by DOE showed that California could theoretically generate all of its daytime electricity from the sun if every available commercial and industrial roof were covered with photovoltaic panels.

U.S. NAVY—BUILDING 850

— Port Hueneme, California

Thanks to Southern California's abundant sunshine, natural light adequately illuminates the interior spaces of this Navy training and conference center on most days. The PV system reduces the need for grid power significantly and provides back-up power for up to eight hours, allowing the building to endure major electrical outages without data or productivity interruption. Other features include an indoor air quality monitoring system, leasing of carpets to ensure recycling of old material into new carpet tiles, and a separate plumbing system that recovers graywater for use in toilets and sustainable landscaping.

HERMAN MILLER/MILLER SQA

— Zeeland, Michigan

This leading office furnishing manufacturer commissioned architects to design an award-winning 295,000 square foot office, manufacturing, and distribution center. The result is a crescent-shaped single-story structure that follows the natural contours of the site, adjoined by an artificial wetland that processes and purifies the building's stormwater. The building is heated and cooled passively and is equipped with state-of-the-art ventilation systems. The entire building is brightly daylit, with roof monitors, skylights, and sloped windows. Artificial lighting is controlled by photosensors that reduce energy consumption substantially. A DOE post-occupancy survey gave the building superior ratings for indoor environmental quality, energy efficiency, and employee productivity.

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Enhanced Security
As domestic fossil fuel supplies are depleted, our nation becomes more dependent on fossil fuels from other countries. Energy efficiency and renewable energy sources can lessen this dependence and help improve national security. Additionally, buildings designed with automated features and businesses engaged in data processing or financial transactions depend on reliable power for their operations. Buildings powered by on-site renewable or super-efficient energy systems, such as photovoltaics and fuel cells, are less susceptible to supply interruptions due to unpredictable circumstances such as natural disasters, power glitches, and world events.

GREEN BUILDING TRENDS

A Rapidly Growing Movement

Ten years ago, the concept of high-performance "green" buildings was difficult to define and the practice even more obscure. Today, advances in technology combined with growing industry awareness and attractive financial incentives and benefits are rapidly transforming the green building landscape. A look at a number of trends reveals that the public, private, and nonprofit sectors are embracing sustainable design as a way to increase the performance of their buildings and the people who inhabit them.

Rapid Market Penetration of the LEED Green Building Rating System and Growth in USGBC Membership
In just three years since the launch of USGBC's LEED rating system, nearly three percent of all new commercial construction projects in the United States—totaling 91 million square feet—have registered for third-party certification. This success has been coupled with a rapid growth of membership in USGBC and demand for the organization's services. Since early 2000, the Council's membership has grown from 250 companies and organizations to nearly 3,000. Conference experts judged the 2002 premiere of the USGBC's International Conference and Expo, which attracted more than 4,000 attendees, one of the most successful start-up events of the year. The diversity of projects registering their intent to obtain LEED certification is another indicator that green building is beginning to influence the mainstream market.

CONDE NAST BUILDING

— Four Times Squares, New York

This 48-story office tower in the heart of downtown Manhattan is the first large-scale speculative green building in the nation. Using 40 percent less energy than the conventional standard for Manhattan, the building features efficient gas-fired absorption chillers and a curtain wall with excellent shading and insulation. PVs integrated into the building's skin produce part of the office tower's electricity, and fuel cells ensure power reliability. The air delivery system will provide 50 percent more fresh air than industry codes, and a network of recycling chutes serve the entire building.

Forty-eight projects have completed certification and more than 700 are in the pipeline. Of these, approximately 39 percent are state and local government projects, 39 percent are private sector, 13 percent are nonprofit, and 10 percent are federal projects. LEED certification projects range from manufacturing

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FEDERAL POLICIES AND PROGRAMS THAT SUPPORT GREEN BUILDING

Federal Laws that Support Green Building Include:
The National Environmental Policy Act (NEPA), 1969; Clean Air Act 1970, amended 1990; Resource Conservation and Recovery Act (RCRA), 1976, amended 1994; and Energy Policy Act, 1992.

Executive Order 13101: Greening the Government through Waste Prevention, Recycling, and Federal Acquisition in response to RCRA 6002 (e) requires EPA to (1) designate items that are or can be made with recovered materials and (2) prepare guidelines to assist procuring agencies in complying with affirmative procurement requirements. Federal agencies (and state or local agencies using federal funds) are required to purchase those items.

Executive Order 13123: Greening the Government through Efficient Energy Management encourages government agencies to promote energy efficiency, water conservation, and the use of renewable energy products by mandating the reduction of federal facility energy consumption per gross square foot by 35 percent by 2010 compared to the 1985 base year. EO 13123 also mandates federal agencies obtain 2.5 percent of electricity equivalent through purchasing renewable power and installing renewable technologies. Recommended energy management strategies include sustainable building design.

Executive Order 13134: Developing and Promoting Biobased Products and Bioenergy aims to triple the national use of bioenergy and biotechnology by the year 2010. It is anticipated that meeting this objective will reduce greenhouse gas emissions by 100 million tons. Through the coordination of federal efforts, technology will be developed that converts trees, plants, and other organic material into energy, while petroleum-based products will be increasingly replaced.

Executive Order 13148: Greening the Government through Leadership in Environmental Management makes the head of each federal agency responsible for ensuring that actions are taken to integrate environmental accountability into agency day-to-day decision-making and long-term planning processes. Goals include Environmental Management, Environmental Compliance, Right-to-Know, Pollution Prevention, Toxic Chemicals Release Reduction, Toxic Chemicals and Hazardous Substances Use Reduction, Reductions in Ozone-Depleting Substances, and Environmentally and Economically Beneficial Landscaping.

Build America is a DOE partnership that provides energy solutions for production housing. The program aims to produce homes on a community scale that use 30 to 50 percent less energy, implement innovative energy and material saving technologies, and help home builders reduce construction time and waste by as much as 50 percent.

EPA's ENERGY STAR is a government/industry partnership that offers businesses and consumers energy efficient solutions. Introduced in 1992 as a voluntary labeling program to identify and promote energy-efficient products, ENERGY STAR works with more than 7,000 public and private sector organizations to improve the energy performance of homes, businesses, appliances, office equipment, lighting, consumer electronics, and residential heating and cooling equipment. Organizations have committed to improve the energy performance of approximately 12 percent of U.S. commercial building space through ENERGY STAR.

DOE's Federal Energy Management Program (FEMP) works to reduce the cost and environmental impact of the federal government by advancing energy efficiency and water conservation, promoting the use of distributed and renewable energy, and improving utility management decisions at federal sites. FEMP provides analytical software tools that perform complex energy consumption analyses and modeling, as well as comparative life-cycle costing analyses. For example, the Building Life-Cycle Cost Program provides computational support for the analysis of capital investments in buildings.

U.S. Department of Education's Healthy and High-Performance Schools program, enacted by Congress in 2001 and advised by EPA and DOE, helps states develop information and grant incentives for green design and engineering of school renovations. (The program has not yet been funded.)

Partnership for Advanced Technology in Housing (PATH) is a national effort launched in 1994 to improve the quality, durability, environmental impact, energy efficiency, and affordability, and decrease the disaster risk of America's homes.

Rebuild America focuses on accelerating energy-efficiency improvements in existing commercial, institutional, and multifamily residential buildings through private-public partnerships created at the community level. Today this DOE program helps communities across the country sort though an often overwhelming array of options for building improvements and develop and implement an action plan.

DOE's Zero Energy Home is part of a national initiative funded by the National Renewable Energy Laboratory (NREL). The Zero Energy Home initiative aims to launch the concept into the mainstream home building industry, especially into the single-family home market.

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plants and convention centers to firehouses and schools. Moreover, 50 states and 9 countries have registered projects, with the top five states being California, Pennsylvania, Oregon, Washington, and Michigan.

Strong Federal Leadership

The current Administration's recent report, "Leading by Example: A Report to the President on Federal Energy and Environmental Management," details the array of initiatives and achievements underway in the federal government. Some projects reflect genesis in President Clinton's 1993 commitment to make the White House a model of energy efficiency and waste reduction. The **Greening of the White House**—a signature partnership among government agencies, professional associations, and environmental leaders—resulted in an annual savings of $300,000 in energy costs, $50,000 in water costs, dramatically improved recycling rates and indoor air quality, and ecological restoration efforts on the 18-acre grounds. Federal agencies have since made critical green building policy commitments for the buildings they manage and the teaming arrangements they make. The Navy, National Park Service, GSA, DOE, and EPA all have initiated polices and projects that embrace sustainable building design. The U.S. Government Accounting Office (GAO) and the National Academy of Sciences (NAS) have documented $30 billion in annual savings from just five of DOE's R&D technologies alone, and NAS added an extra $60 billion in environmental benefits.

"Federal greening efforts at the White House, Pentagon, Grand Canyon, and Yellowstone National Parks help set the course for similar efforts for states, local governments and corporate owners of real estate."

—Bill Browning, Rocky Mountain Institute

Public and Private Incentives

To make building green more attractive, many public and private entities offer financial and regulatory incentives. New York, Maryland, and Oregon are on the leading edge of states offering tax credits for LEED certified buildings. Portland (OR) and Seattle (WA) offer grants for energy modeling, commissioning, and related costs. The private Green Building Loan Fund in Pittsburgh, underwritten by The Heinz Endowments, does much the same on a loan basis. Arlington County, (VA) links preferred zoning considerations for LEED projects. Santa Barbara (CA) and Scottsdale (AZ) are some of the first jurisdictions to offer expedited permit reviews for

Spotlight on The General Services Administration

GSA is the federal government's largest civilian property management organization and provides facilities for over 1.1 million federal associates. The agency is responsible for managing more than 8,300 government owned or leased buildings, oversees federal product procurement, and manages the construction of new federal facilities, such as office buildings, border stations, and courthouses in all 50 states. GSA, which was the first federal agency to join the U.S. Green Building Council, has formalized its commitment to building green:

- **GSA adopted the LEED rating system as both criteria and a measure of success. A LEED rating level of Certified is required for all new design starts beginning in fiscal year 2003 with a target of LEED Silver rating. Twenty GSA projects are working toward LEED ratings, more than any other organization in the country.**
- **GSA, the Department of the Interior, and the USGBC signed a Memorandum of Understanding pledging cooperation and support to promote the use of sustainable practices and products in building design, construction, and operation.**
- **Strong sustainable design language has been incorporated into key documents, including GSA's Facilities Standards design guide and the Design Excellence program guide, which governs the selection of architects and engineers.**
- **Build Green principles are now part of every GSA lease solicitation.**
- **GSA created a Build Green Network of associates in every region and trained more than a thousand federal agency associates in sustainable design in two years.**
- **GSA provided renewable energy to power 17 percent of DOE's energy needs at its headquarter buildings in Washington, DC and Germantown, Maryland.**
- **Energy consumption in GSA buildings has declined by 22 percent since 1985 and recycling is nearly universal at GSA managed facilities.**

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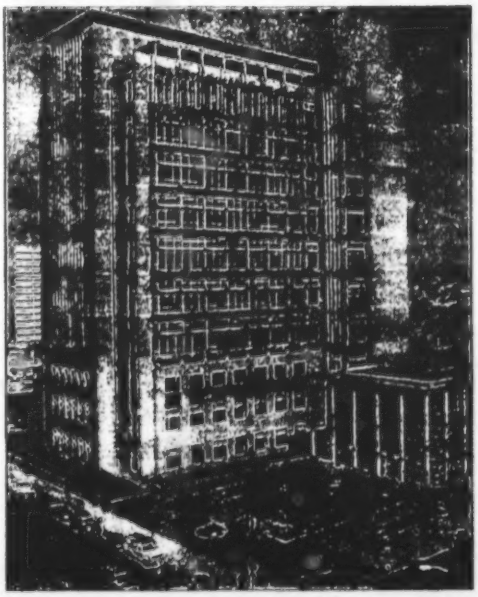

Credit: Greg Hursley

ALFRED A. ARRAJ U.S. COURTHOUSE

— Denver, Colorado

This showcase green courthouse adds to GSA's growing portfolio of high-performance green buildings. Dedicated in October 2002, the courthouse is expected to consume approximately 43 percent less energy than a standard building. Design strategies that helped achieve this goal include high-performance glazing, maximum use of natural light, displacement ventilation, energy-efficient electric lighting, variable speed air handling, and building integrated PVs. The building also serves as a model for designs that balance security and sustainability. The project budget was increased approximately 7 percent to cover environmental features.

buildings with certain high-performance features. California and several other states and jurisdictions offer significant rebates as incentives to buy down the cost of on-site renewable energy systems. Meanwhile, the Kresge Foundation, provider of $120 million in challenge grants for capital projects in 2000, is launching an initiative to support design, planning, and educational assistance for LEED-certified buildings in its portfolio.

Expansion of State and Local Green Building Programs

Tax credits and other incentives are part of broader green building assistance programs offered by a growing number of state and local governments across the country. Government entities that have developed green building programs include the states of California, Colorado, Maryland, New York, Pennsylvania, and Wisconsin; Alameda (CA), King (WA), and Cook (IL) counties; and numerous cities, including Austin and Frisco (TX), Boulder (CO), Portland (OR), Los Angeles, Santa Monica, and San Jose (CA), Scottsdale (AZ), and Seattle (WA).

"We view green buildings as part of our commitment to world class workplaces. Our pursuit of green buildings is a constant effort to find that delicate balance between value to taxpayers, responsible management, efficient operations, and social and environmental responsibilities."

—Stephen [illegible], GSA Administrator

Industry Professionals Take Action to Educate Members and Integrate Best Practices

A growing number of professional associations have worked to promote green building policies and practices within the design, construction, and real estate communities. The American Institute of Architects' Committee on the Environment has been a leader in promoting sustainable design practices for more than a decade. The 20,000 member Construction Specifications Institute has worked closely with the USGBC on several projects including the Council's new International Conference and Expo ("GreenBuild") on green building. Well-known architecture firms are integrating green building components into sizeable commercial and institutional projects. The National Association of Home Builders offers resources and meetings to encourage environmentally responsible home building. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standards—which are some of the most comprehensive and widely accepted in the world—now set energy-efficient design standards for new commercial buildings and technologies. The Urban Land Institute and Real Estate Roundtable have partnered with USGBC on projects such as producing the "Making the Business Case for High Performance Green Buildings" document and hosting symposia.

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Corporate America Capitalizes on Green Building Benefits

Green building practices are spreading beyond office buildings to all business sectors, including manufacturing, retail, and hospitality industries. **Steelcase, Herman Miller, Johnson Controls, Interface, PNC Financial Services, Southern California Gas Company,** and **Ford Motor Company** are among the many large corporations in the United States that are designing or have constructed flagship high-performance green buildings. Moreover, large real estate developers such as Hines Development are incorporating green building designs and technologies to provide a better product and experience for their tenants and more value for their investors.

> *What we know now*
> *is that the old story about there being a conflict*
> *between environmental performance*
> *and economic performance is a myth.*
> *It's very clear, and smart American corporations*
> *are proving this on a daily basis,*
> *that both move in the same direction.*
> *It's just a matter of looking more intelligently,*
> *being smarter about making decisions,*
> *and looking more broadly in an integrated way*
> *at our decisions before we make them.*
> *When we do that, in fact, we improve*
> *our economic vitality*
> *as we restore the environment.*
>
> —Bob Berkebile, Architect

Advances in Green Building Technology

Green building technology has evolved dramatically over the past decade. Once uncommon, resource-efficient and energy-saving products and designs are now widely recognized as mainstream. Super-efficient windows, daylighting strategies, reflective roofing material, efficient lighting systems, and low-VOC paints have all gained widespread acceptance in the building industry. Yesterday's unreliable and unaffordable photovoltaic (PV) materials have evolved into a new generation of technology that can replace conventional elements of the building envelope, thanks to space-age material development supported by NASA. And the prices for many green building technologies have dropped considerably. Since the 1970s, the installed costs of PV systems, for example, have decreased by nearly an order of magnitude.[9]

BARRIERS

Although recent market interest in high-performance green buildings is encouraging, the enormous scale of missed environmental, economic, and health opportunities has important national implications. These foregone benefits are particularly significant given that building stock turnover is measured in decades, compared with the much shorter turnover times of nondurable consumer goods. Why do the vast majority of buildings constructed today miss out on the wealth of green building opportunities? What can be done to accelerate the normal rate of market transformation in an industry characterized by relatively low rates of technology innovation, small profit margins, and minimal research investment? Owners, developers, local governing boards, and managers still face obstacles that impede universal adoption of green building practices.

Financial Disincentives

Lack of Life-Cycle Cost Analysis and Use

Of the total expenditures an owner will make over the span of a building's service lifetime, design and construction expenditures, the so-called "first costs" of a facility, account for just 5-10 percent. In contrast, operations and maintenance costs account for 60-80 percent of the total life-cycle costs.[10] Unfortunately, decision-makers rarely use life cycle cost analysis to link capital and operating expenses. Therefore, energy savings, decreased worker absenteeism, and higher productivity are not universally accounted for in the cost equation. Only when savings from operations and maintenance and improved worker health are accounted for up front will decision-makers readily select high-performance design.

Real and Perceived Higher First Costs

While many green buildings are designed and constructed at comparable or even lower costs than conventional buildings, environmental performance features can add costs to design and construction expenditures. According to green building professionals, such initial cost increases generally range from an average of 2 to 7 percent, depending on the design and extent of added features. Typical building accounting often takes a short-term perspective, overlooking the interrelationships between a

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building and its components, occupants, and surroundings. Without an accepted "whole building" approach, decision-makers will remain biased toward lower first costs.

Budget Separation Between Capital and Operating Costs

While federal managers are required to conduct a certain level of life-cycle costing, the Office of Management and Budget (OMB) fails to prioritize projects based on life-cycle net savings. This flaw in the federal accounting process, along with fixed budgets, prevents federal agencies from making additional investments up-front to reduce the lifetime costs of a building. Such investments would save taxpayers money.

Security and Sustainability are Perceived Trade-Offs

Since the events of 9/11, federal construction projects have placed a priority on security, thereby shrinking available funds for environmental features. As long as security and sustainability are viewed as competing for the same limited resources instead of striving to achieve mutual long-term goals through integrated design, high-performance green features and security measures will be perceived as goals in conflict instead of areas of potential synergy.

Inadequate Funding for Public School Facilities

School districts face numerous hurdles in their efforts to secure school construction financing. Problems can include lack of voter support for bond acts or increased tax levies; delays in plan approvals that result in higher actual costs; changes in state assistance levels; and piecemeal renovation and expansion projects that preclude a more efficient, whole-building approach.

Insufficient Research

Inadequate Research Funding

The European Union, recognizing the energy and public health benefits at stake, spends six times more than the United States on research devoted to the built environment. Despite strong evidence that indoor environments can affect health and learning, the major research funding agencies—NIH and NSF—have no programs dedicated to building research. Although buildings consume 37 percent of total U.S. energy resources, DOE allocates less than 3 percent of its budget to building research. Less than 1 percent of funds allocated for federal energy use is fed back to the FEMP for long-term energy improvements despite the fact that government's building-related energy costs have dropped 23 percent in two decades due to energy efficiency improvements. International studies and evidence from U.S. buildings have begun to link green design features with improved productivity, health, and learning, but robust scientific analyses are needed to verify findings and quantify real benefits resulting from enhanced indoor environmental quality.

Insufficient Research on Indoor Environments, Productivity, and Health

Preliminary research and anecdotal evidence linking green design features with improved productivity are compelling, but robust studies are needed to verify and quantify productivity gains. A healthy indoor environment has not yet been characterized, and there is no widespread agreement about what constitutes "good" or "acceptable" levels of indoor air quality for adults or children. There is no national goal to research the relationship between asthma or learning deficits and school building conditions and practices. While NIH has a major effort underway to study asthma, funding is allocated to study its indices and cures, not environmental drivers such as building-related conditions. The role of the built environment in public health needs to be acknowledged by those who establish research priorities. Only then will society reap the benefits of improved health, student performance, and worker productivity.

Multiple Research Jurisdictions

No single federal agency or organization holds the vision for the integrated, cross-disciplinary research that needs to be done regarding the built environment. NIH, the National Institute of Standards and Technology, DOE, EPA, the National Institute of Building Sciences, and NSF all have addressed segments of the issue. However, it is not apparent that any one of these entities places the full integration of this work on its list of priorities or even within its mission. Holistic research is needed that examines the environmental, engineering, energy, and public health factors involved.

Lack of Awareness

Conventional Thinking Prevails

While environmental materials and methods are capturing the attention of a growing sector of the building industry, most architects, builders,

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developers, and their clients remain unaware of the full range of benefits associated with sustainable and healthy building practices. Many mainstream decision-makers have not yet been convinced that high-performance design is good business practice. Moreover, industry professionals are often uninformed about how to access tools and information to help educate decision-makers about green building. Additionally, public schools are highly decentralized with unreliable sources of construction funds, extremely tight budgets, and little oversight.

Aversion to Perceived Risk

The building industry is characterized by relatively slow rates of innovation due to its size, diversity, fragmentation, and low investments in research and demonstration. Indeed, such factors were primary considerations in forming the U.S. Green Building Council ten years ago. Public sector members at the federal, state, and local levels contribute important perspectives to the private sector-led organization.

RECOMMENDATIONS

What Can Congress and Federal Agencies Do?

The federal government is demonstrating a strong commitment to green building. However, further action by the federal sector could help drive down costs and strengthen markets for established but still niche market technologies, provide stakeholders with needed tools and incentives, and fill research gaps to bolster existing studies with robust scientific evidence. These efforts would help convert a growing movement to a national trend and establish the United States as a world leader in high-performance green buildings and technologies.

"The rate at which high-performance green buildings become conventional practice will be influenced in good measure by actions taken by the federal government."

—Christine Ervin,
President and Chief Executive Officer,
U.S. Green Building Council

Federal Policies and Incentives

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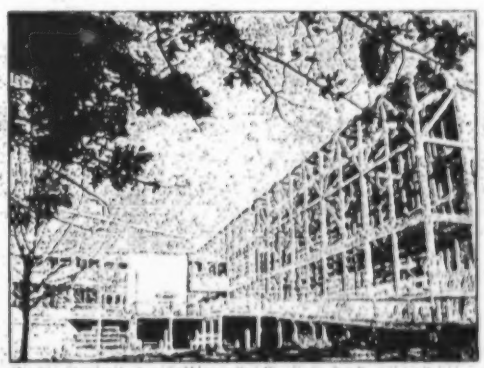
Strengthen existing federal policies relating to green building.

Many of the Executive Orders and legislation put in place to foster green building design, construction, and operation within the federal government provide exceptions that diminish their objectives. Efforts should be taken to strengthen and integrate federal policies to maximize their effectiveness.

Promote LEED as the national green building standard for federal buildings.

Promoting LEED as the green building standard for new federal building construction will generate more environmental, economic, and health benefits while continuing the current statutory emphasis on energy



PHILIP MERRILL ENVIRONMENTAL CENTER/CHESAPEAKE BAY FOUNDATION HEADQUARTERS

— Annapolis, Maryland

In designing a new headquarters for this large environmental organization, architects created an icon for sustainability. The 32,000 square foot office building, located on 31 acres near the shore of the Chesapeake Bay, includes solar panels, natural ventilation, a geothermal heat pump with a desiccant dehumidification system, and roof and wall enclosures of structural insulated panels. Clad in galvanized siding made from cans, cars, and other recycled metal objects, the building was designed to use 90 percent less potable water and 70 percent less energy than a typical office building. The building was the first to receive a LEED Platinum rating.

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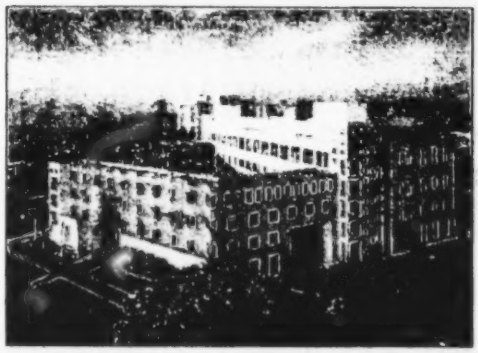

DONALD BREN SCHOOL OF ENVIRONMENTAL SCIENCE & MANAGEMENT

— University of California, Santa Barbara

This $26 million laboratory building incorporates sustainable practices and materials into virtually all of its 85,000 square feet. Features in the LEED 1.0 Platinum building include rooftop PV energy generation and purchased energy from recovered landfill waste gas; materials made from post-consumer recycled products; building orientation and ventilation that maximizes daylight and outside air; operable windows and motion sensors that minimize generated energy use; a variable air volume system that automatically corrects for pressure changes in the labs; and use of reclaimed water for landscape irrigation and waterless urinal technology. Ninety-three percent of the construction waste was recycled, and all of the materials in the building are free of asbestos, formaldehyde, and CFCs.

Credit: Tim Griffith

efficiency. As experience with LEED develops, federal agencies should strive to meet a LEED Silver rating for all new construction. Congress should also consider replacing the current Energy Conservation and Production Act (42 USC 6834) requirement that establishes an energy efficiency standard for all new federal commercial and multi-family high-rise residential buildings with a broader mandate to ensure the sustainability of all federal buildings.

Restructure capital budgets to reflect full-cost accounting and create tools and incentives to move federal agencies and Congress beyond first-cost construction.
Federal managers are required to use Building Life-Cycle Analysis (LCA) on all projects. However, budget and schedule issues often shift priorities away from high-performance features that yield the best return on taxpayer investments. Life-cycle analysis tools should also be designed with the end-user in mind. They should use the language of the intended audience—designers, facility managers, asset managers, accountants—to catch their attention and ensure ease of use. Developing LCA will require research, database development, and initial incentives.

Establish a federal performance-based tax credit to encourage more rapid adoption of energy-efficient and green products and practices.
States and local governments are proving that modest tax credits can stimulate market interest in green building practices by offsetting any additional upfront costs such as energy modeling and commissioning. Tax credits should be tied to LEED certification to assure that projects deliver promised results and to speed overall market transformation. Such tax credits should apply to both the commercial and residential markets.

Federal Program Development and Coordination

Coordinate federal agency green building initiatives into a cohesive program.
Many federal agencies and departments, including EPA, GSA, and DOE, currently manage a slice of the green building pie. For example, FEMP coordinates much of the federal government's existing green building efforts, though the program has a predominant focus on energy as part of DOE. Green building by definition is an integrated approach and requires coordination across these jurisdictions. An umbrella office that linked federal green building programs as part of a single program effort would create a one-stop-shop for both internal agencies and external stakeholders. Another consideration is to develop a federal green team built on the Sustainability Council launched by FEMP to coordinate resources and review funding for federal research. A branded program such as LEED would offer the government and program partners visibility, recognition, and market differentiation and would help galvanize stakeholders and accelerate high-performance green building practices.

Develop a product label for green building materials and technologies.
ENERGY STAR began as a labeling program to identify and promote energy-efficient products. However,

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energy efficiency is only one component of a truly green building. Other labels such as the proposed "Bio-based products" provision of the Farm Bill address pieces of the green building picture. A comprehensive label for a wide range of green building materials and technologies would go far to offer businesses, consumers, and federal procurement officers clear product choices for high-performance green buildings. Product label criteria should take into account a product's full energy and environmental costs from the point of extraction through disposal.

Award leadership.
Efforts should be taken to continue recognizing federal agencies and program partners for their leadership in achieving green building standards and demonstrating benefits. (The White House Closing the Circle Awards, which focus on recycling, have been expanded to include green buildings. FEMP also gives awards for Energy and Water Efficiency.)

Technical Assistance & Public Outreach

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Establish a national database and information clearinghouse for green buildings.
While an overwhelming amount of information relating to green building exists within federal agencies, state and local governments, and industry, it is often difficult to find. A national database and information clearinghouse could provide readily accessible case studies, fact sheets, research studies, and documentation of green building benefits. These resources would help decision-makers overcome the bias presented by potentially higher first costs. In the short term, http://www.eren.doe.gov/buildings/highperformance/case_studies/index.cfm should be used while a more comprehensive database is developed.

Develop and promote benchmarking tools.
Most experts agree that ENERGY STAR is a strong program for benchmarking energy performance. However, an integrated, whole-building approach requires scientifically based, technically sound benchmark standards for all aspects of a building, including productivity and indoor air quality. Such data can be used to further enhance the robustness and effectiveness of environmental rating tools such as LEED.

Collaborate with the private sector to promote the business case for high-performance green buildings.
The federal government is a natural broker of credible research findings on high-performance green buildings including data on costs, labor productivity, investment, health and comfort, and national security benefits.

Support the development of simple calculation and simulation tools.
These tools should be geared toward integrated green building assessment as opposed to a single media approach. DOE-2 (soon to be replaced by Energy-Plus), a computer program that aids in the analysis of energy usage in buildings, is a good model. Likewise, support is needed to develop cost-effective building commissioning tools and incentive programs for their use.

Support public education and outreach efforts.
A national outreach campaign would increase consumer demand for high-performance green buildings. Public education would also help transform the image of green buildings—which today tend to be viewed as costly and complex—into desirable alternatives that are easily within the reach of any prospective home or building owner. Continued support for training programs for building industry professionals would also further increase awareness and knowledge among architects, designers, builders, developers, and other industry professionals.

Support the development of innovative materials, products, and systems that maximize natural space conditioning and energy efficiency.
The United States can be a leader in green building technology development and can use its tremendous purchasing power to expand both domestic and export markets. Federal policies such as EO 13134 for bio-based materials and EO 13101 for recovered content are good models for market development. Similar polices could be developed for other products, including carpet and fabrics.

Research

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Increase funding for basic high-performance green building research.
Many experts identify research as the single greatest need the federal government can address. The design, construction, and operation of buildings account for 20 percent of the economy and more than 40 percent of the energy consumption.

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pollution, and waste in the United States, but far less than 1 percent of the federal research budget is allocated to buildings. Much needs to be learned about how natural systems can be used as models for the design of materials and construction, how energy and air move through structures, and how humans interact with the built environment. The federal labs are conducting important research, but additional funds made available through NSF and other entities would help fill critical research gaps. Research funding should support universities and laboratories working in collaboration with industry to develop the next generation of high performance building materials, components, and integrated systems.

Support funding for "breakthrough" energy-efficient and renewable technologies.
Breakthroughs are needed to reduce the installed cost of PV systems, improve the performance of water heating and lighting systems, enhance the thermal properties of insulation products, improve the cost effectiveness of fuel cells, and to pave the way for commercialization of many other promising technologies. The DOE Office of Energy Efficiency and Renewable Energy should enhance its Building Technology, Distributed Energy and Electric Reliability, Solar Energy Technology, and Industrial Technology programs to foster breakthrough technologies.

Increase funding for applied building research to document links between indoor environmental quality, human health, and productivity.
Preliminary studies are showing an increase in the performance of office workers and a decrease in absenteeism due to the design of high-performance green buildings. Energy leaders such as Carnegie Mellon's Center for Building Performance, Berkeley's Center for the Built Environment, and the Rocky Mountain Institute have published numerous studies on the benefits of green design, but additional scientific studies are needed to verify preliminary findings and help galvanize industry support.

Recommendations to Improve School Environments

Strengthen EPA's Schools Program.
EPA's healthy school environment initiatives should be made a clear agency priority and resources should be invested to improve the environmental health of public schools. Guidelines for new school siting, construction, and operation should take children's size and development needs into consideration. New school siting should not be permitted on or adjacent to known hazardous facilities. Best practices for school facility maintenance and product procurement should be consistent with the federal executive order on Environmentally Preferable Purchasing. The IAQ Tools for Schools program should be evaluated specifically for its impact on health and learning. Education and outreach needs to be expanded to include federal and state agencies and other key constituencies and to address other important school environmental issues such as evacuations due to chemical spills and construction fumes, radon, lead, asbestos, and pest control. Moreover, a system for more regular school facility monitoring should be developed.

Fund and implement the Healthy and High-Performance Schools provisions enacted in the Leave No Child Behind Act of 2001.
The provisions call for (1) a U.S. Department of Education study of the impact of decayed environments on child health and learning and (2) state grants to develop high-performance school information programs and fund technical assistance in design, engineering, and materials specifications for school renovations in needy local districts. Unfortunately, budget constraints have left the program unfunded, although the Department of Education has developed some initial information on the study requirements. Congress should fully fund this initiative.

Fund school health and safety repairs.
Congress provided $1.2 billion in 2001 for urgent school renovation grants to address indoor environmental problems as well as disability and technology access. The Administration has not renewed this funding. These funds would be allocated to states and include funding for disability and technology access.

Establish standards for indoor air quality.
Standards for commercial offices and housing should be set independently from schools. Standards for schools should take into consideration child environmental health and learning characteristics, as well as the unique characteristics of school facilities as densely occupied and under-maintained workplaces. Students who are disabled and health-impaired may be even more vulnerable to the impacts of adverse environmental conditions, such as, poor daylighting and acoustics and indoor air quality problems.

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Fund school environmental quality research.
Good scientific data are needed to better understand the relationships between outdoor and indoor environments and student health and learning. Research should also focus on student illness and injury and risk prevention.

Expand the role of the federally funded pediatric environmental health research centers.
These centers should participate in on-site school environmental investigations and work cooperatively with the states to advance child environmental health concerns in schools, day care, and other indoor environments.

Pass the School Environmental Protection Act.
SEPA would require schools to practice facility maintenance in a manner that prevents pests and controls them with least-toxic pesticides.

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